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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/864,666	05/23/2001	Rosalinda M. Ring	AMDA.497PA	3832

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EXAMINER

UMEZ ERONINI, LYNETTE T

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 07/02/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/864,666

Applicant(s)

RING ET AL.

Examiner

Lynette T. Umez-Eronini

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) 15-21 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-14 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 1-14 in Paper No. 6 is acknowledged.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

3. Claims 1-7, 10-14, and 22-23 are rejected under 35 U.S.C. 102(e) as being anticipated by Scott (US 6,407,001 B1).

Scott teaches, "In the context of forming integrated circuit dies or chips, the devices of such dies or chips are generally tested in a variety of ways prior to release or sale" (column 1, line 44-46). "A method . . . includes introducing a focused ion beam (FIB) and an interactive species to a metal material on a substrate within a processing chamber and etching the metal material" (column 2, lines 28-31). "A suitable FIB is, created from a gallium source and the gallium ions produced in the beam are used . . . to break up the copper materials . . ." (column 4, lines 1-8). The above reads on,

A method for focused ion beam (FIB) gas-assisted etching (GAE) of an integrated circuit. Scott also teaches, "In another embodiment, the interactive species is

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introduced in the context of a two-stage process, wherein a first species, such as oxygen is introduced with the FIB and a second species such as xenon fluoride, is then introduced to remove any residual copper material following the patterning" (column 4, lines 18-23). "Still referring to FIG. 4, . . . Pressure regulator **172** monitors the pressure of the volume inside chamber **150** and . . . the desired pressure in chamber **150** is maintained by introducing gases into chamber **150** . . ." (column 4, lines 54-62). "The amount of oxygen delivered to a chamber to achieve the desired etch characteristics is determined by the chamber pressure and the source gas. . . . The pressure can range from 1×10^{-5} Torr to, . . . 1×10^{-4} Torr" (column 6, lines 23-24). The aforementioned reads on,

supplying etch gas, including a halide gas, to the die; and

etching a selected portion of the die using the etch gas and an ion beam directed at the selected portion, **as in claim 1**;

wherein the etching includes using a vacuum chamber, **as in claim 2**;

attaching a nozzle to the oxygen-containing gas supply outlet, the nozzle being adapted to direct oxygen-containing gas to a selected portion of the die during etching, **in claim 6**; and

encompassing wherein the pressure in the chamber is maintained between about 5.0 E^{-6} and 1.0 E^{-5} Torr, **as in claim 5**.

Scott teaches, " . . . oxygen supplied by an oxygen source gas, such as pure oxygen, or a gas with an oxygen species (nitrogen oxide, nitrous oxide, . . . etc.)" column 4, lines 9-12) which read on,

supplying sufficient oxygen-base gas includes supplying a gas selected from the group consisting of oxygen, **in claim 14.**

Since Scott uses the same etching method and etchants to etch the same material as in the claimed invention, then using Scott's method in the same manner as that of the claimed invention would inherently result while etching the die, supplying sufficient oxygen-containing gas to the die to inhibit corrosion of a portion of the copper in the die being exposed to the etch gas, **as in claim 1;**

wherein supplying sufficient oxygen-containing gas includes opening an oxygen-containing gas valve to an oxygen-containing gas supply outlet in the vacuum chamber and maintaining a selected pressure in the chamber, **as in claim 3;**

wherein supplying the etch gas includes supplying sufficient oxygen to the die to inhibit corrosion of a portion of the copper in the die being exposed to the etch gas, **in claim 7; and**

wherein supplying sufficient oxygen-containing gas includes using oxygen as a gettering agent, **in claim 10.**

Scott further teaches, "In the context of forming integrated circuit dies or chips, the devices of such dies or chips are generally tested in a variety of ways prior to release or sale. In a typical process, an integrated circuit design is configured into a blueprint which is copied by complex machinery into a physical structure. Once defined, the physical structure is simulated prior to marketing. Due to pushing technology limits, simulations are generally not fully sufficient to represent actual product performance. Based on this reality, a physical structure of an original design product is fabricated

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(FAB) and the product enters a debug cycle" (column 1, lines 44-54). The simulation of the physical structure of the integrated circuit dies prior to marketing, reads on,

prior to etching the die, further comprising etching a test die in the chamber, the test die having similar copper structure to the die to be etched. Since uses the same FIB method, etchants, and processing parameters in etching the same material as in the claimed invention, then using Scott's FIB method in the same manner as that of the claimed invention would inherently result in determining therefrom a selected pressure to maintain via the oxygen-containing gas supply that prohibits corrosion of the copper, **in claim 4;**

further including analyzing the die after supplying sufficient oxygen-containing gas to the die, **in claim 22;** and

further including obtaining results in response to analyzing the die, and using the obtained results to manufacture additional semiconductor devices, **in claim 23;** and further reads on:

detecting a level of halide in the chamber prior to etching the die with an ion beam, and would inherently result wherein etching the die includes etching in response to the detected halide level being below a threshold level defined as a function of the die, the etching and the supplying of oxygen-containing gas, **in claim 11;** detecting a level of halide in the chamber prior to supplying sufficient oxygen-containing gas to the die, and would inherently result wherein supplying sufficient oxygen-containing gas includes supplying an amount of oxygen in response to the detected halide level, **as in claim 12;** and the threshold level is selected such that levels of halide below the

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threshold level produce an amount of corrosion with copper in the die that is below an acceptable design amount, **in claim 13**.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Scott (US '001 B1) as applied to claim 1 above, and further in view of Chang et al. (US 6,580,072 B1).

Scott differs in failing to teach the halide gas includes at least one of: chlorine, bromine and iodine.

Chang teaches, "Conductive element **150** is to be cut using an enhanced FIB etch that employs iodine gas. Other gases, such as chlorine and bromine, can also be used to enhance the etch. The reactive gases used to enhance the etch would severely damage neighboring copper structures (e.g., conductive element 165) in the absence of some protection. Thus, referring to FIG. 3, a protective copper oxide layer 305 is grown on the expose surfaces of conductive elements **150** and **155**" (column 3, lines 45-53).

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Scott by using

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Chang's FIB method of etching copper with a halide gas in etching copper for the purpose of eliminating the step of supplying an oxygen containing gas to copper to inhibit corrosion.

6. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Scott (US '001 B1) as applied to claim 1 above, and further in view of Birdsley et al (US 6,210,981).

Scott differs in failing to teach wherein the die includes a flip-chip type die having circuitry in a circuit side opposite a back side, and wherein etching the die includes at least one of: etching the die from the circuit side and etching the die from the back side.

Birdsley teaches, "In the past the die and package were first attached and then the electrical connections from the die to the package were made by wire bonding. . . . Wire bonding between a die and a package has several problems. One problem is that a wire bond attachment to a die limits the number of pads and placement of the pads on the die. In addition, minimum height limits are imposed by the required wire loops. Another problem is that there is a chance of electrical performance problems or shorting if the wires come too close to each other. . . . This could limit acceptable signal speed in the system. . . . To increase the number of pad sites available for a die and to address the problems stated above and other problems, a different chip packaging technique called controlled collapse chip connection or flip chip packaging has been adopted" (column 1, line 36 – column 2, line 5). "FIG. 3 shows a schematic view of an example system 300 for etching the backside of flip chip type die 12 and controlling the etch by monitoring the number of secondary particles emitted from the flip chip during

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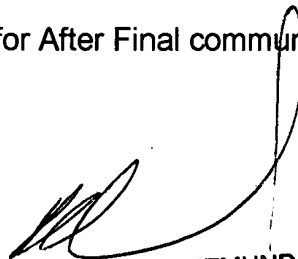
etching. System **300** includes focused ion beam (FIB) generator **302** for generating focused ion beam 304 which, in the presence of a gas that is reactive with the substrate, is used to etch the die. The reactive gas may be, for example, xenon difluoride or chlorine" (column 5, lines 57-65).

It is the examiner's position that it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Scott by using Birdsley flip chip type die for the purpose of solving electrical performance problems or shorting if the wires come too close to each other (Birdsley, column 2, lines 1-2 and column 1, lines 60-62).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 703-306-9074. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703-308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

ltue
June 26, 2003



ROBERT KUNEMUND
PRIMARY EXAMINER